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NOTES AND LITERATURE

EXPERIMENTAL ZOOLOGY

Przibram's Experimental Zoology, of which Part I has just appeared,¹ is an enlargement of his brochure of 1904. It is the author's purpose to publish four other parts dealing respectively with Regeneration, Phylogeny, Vitality and Function.

The present volume brings together the modern experimental work dealing with the egg and embryo. The results are grouped under the headings of Fertilization, Egg-structure, Karyokinesis, Gastrulation, Developmental Mechanics and Influence of Environment. There is a very full bibliography, and sixteen partly colored plates. These plates contain many figures familiar to the student of modern literature of the subject. The figures are often too small and their arrangement in plates at the end of the book is not as advantageous as figures at suitable places in the text would be, nor would their simple character preclude their insertion as text figures.

The book will prove most useful, giving as it does a very complete résumé of the subject. The matter is treated in large part as a series of reviews under topic-headings of the results obtained by each author, and in the present state of the subject no other method is perhaps feasible; but while this treatment is satisfactory as a résumé of what has been done, it is not an arrangement that furnishes entertaining reading to the uninitiated.

At the end of each chapter the author attempts to draw general conclusions from the evidence reviewed, and inasmuch as these conclusions serve to register the author's point of view we may examine them in some detail.

The work of recent years on artificial parthenogenesis leads to the conclusion, in the author's opinion, that the cause that calls forth the further development of the quiescent egg-cell is to be found in the hastening of the vital processes already existing in the egg by means of the withdrawal of water from the

¹ *Experimental Zoologie. Part I, Embryogenese.* By Hans Przibram. Franz Deuticke, Leipzig, 1907.

egg. Normal fertilization is supposed to act in the same way. The evidence at hand does not appear to the reviewer to substantiate this generalization, because the shrinkage sometimes observed in the normal egg may be an effect of changes taking place rather than their cause, and because, in the second place, some of the most recent results, especially those with weak acids (Lefevre), can scarcely be interpreted on Przibram's view. There are some indications, on the contrary, that fertilization is a vital act in the sense that the sperm is a stimulus starting development in the same way that many external agents call forth the nerve impulse in a nerve. Here also in the nerve the same impulse may be called forth either by internal factors or by external agents. The intimate nature of irritability of living material remains, however, as much of a puzzle to the physiologist as to the embryologist.

The occurrence of visible inclusions in the egg,—pigment, yolk, granules, etc.,—leads the author to conclude that even before fertilization the egg is made up of different substances, which “guarantee” the subsequent development. We touch here on one of the burning questions of modern embryological speculation, for while certain evidence seems to show that different substances contained in the egg furnish a “guarantee” of diversity, still the central problem remains untouched, for few, if any, experimentalists will admit unreservedly that these materials are preformed primordia, or organ-forming substances in a strict sense, rather than that their presence is a condition that prejudices in certain directions the subsequent development. In other words we are still unable to state how far and in what sense the development is due to preformed materials and how far it is an epigenetic phenomenon depending on the relation of the parts to each other in a dynamic sense. It may be well in the present unsettled state of the subject not to prejudice these questions, for, there may be truth on both sides, since predetermination and epigenesis are not mutually exclusive possibilities, but rather complementary.

In regard to the location of the first cleavage plane, Przibram points out that this is “given” by the location of the segmentation spindle. The position of the spindle itself is the result of the egg structure, the geometrical form of the egg and the meridian of fertilization. The position of the spindle in any particular case may be due to any one or to more than one of these factors. The causal problems still remain to be considered.

The division of the centrosomes, the formation of the astrosphaeres, the division of the chromosomes and of the cytoplasm, are not to be considered, according to Przibram's summing up, as constituting a series of causally connected events, but are the result of the same primary cause. While this point of view is sympathetic to the reviewer also, it should be clearly understood that we entirely lack sufficient evidence to establish such an attractive interpretation. Even if all these changes are the result of one cause, we can form no conception of what that cause may be. Our author's conclusion, at the end of the next chapter, to the effect that this common cause is to be found in a system of surface tensions, can scarcely be said to be at present more than the working hypothesis of a few thinkers of the school of developmental mechanics. One does not have to look very far for facts that are difficult to explain on such a view.

It is pointed out at the end of chapter VI. that the arrangement of the blastomeres conforms to Plateau's law of minimal surfaces. While it is true that such a law may appear to account for cell arrangement, we should not overlook the fact that a similar arrangement follows if the cells are simply flattened against each other by pressure from outside. Possibly also the mutual flattening—an active process—of the cells themselves might give the same arrangement. Therefore we do not know that surface tension plays even the chief rôle in the result. In fact, the author himself concludes in the next chapter that gastrulation is the outcome of chemotactic action, *i. e.*, of an active wandering of the cells. Such a conclusion appears to admit that the characteristic feature of formative processes may be responsive in its nature rather than chemical or physical.

The chapter dealing with the developmental mechanics of differentiation takes up the extensive literature describing the results of isolation of the blastomeres and of injuries to the egg. A very complete and impartial review is given here. Przibram attempts to interpret the results in the following way. Different chemical stuffs are supposed to be present in different zones of the egg and these lead to the differentiation of the different organs. If parts of the egg are removed and no rearrangement of the formative stuffs occurs, partial development takes place; but if a rearrangement follows, so that the parts recover their normal relations of position, a whole embryo of smaller size results. That the different parts of the egg play the rôle here

assigned to them can not be denied, and this is the simplest interpretation that embryologists have given to their results; but it is improbable that the differences between whole and partial development rest on this condition alone. The phenomena are really more complicated, as shown when whole development occurs even after the materials of the egg have become shut up within cells, and as shown in regeneration when a whole animal of smaller size develops from a part of the body of a fully formed organism.

The final chapter deals with the influence of external factors, and, although compressed into very small compass, most of the modern work is referred to at least briefly. The author's conclusion that external factors play in most cases only a minor rôle in development will be conceded by most students of experimental embryology. Nevertheless, important results have been already obtained from a study of external factors and our causal knowledge of the physiology of development rests in the main on evidence from such studies. Whether the formative changes are simply a complex of physiological relations or depend on factors not usually considered by physiologists is at present a question of opinion rather than of demonstration.

While we have found ourselves obliged in many cases to urge that many of the conclusions reached by the author still remain uncertain, and in other cases to take issue with the author's summaries of the present state of affairs, yet it should be repeated that the chief value of the book lies less in such generalizations than in the conscientious, full and exact review of the literature. The results so far obtained are marshaled forth in excellent order and the book is a valuable storehouse of materials, and will be found useful not only to those who do not have access to the original literature or time to digest it, but also to those who have felt themselves somewhat overwhelmed by the rapid development of this branch of embryology. The general reader, too, will find in this volume a well-balanced summing up of the more important results of the school of experimental embryology.

M.

ICHTHYOLOGY

Jordan on Fishes.¹—In a single large volume President Jordan presents "virtually all the non-technical material contained in

¹ Fishes. By David Starr Jordan, President of Leland Stanford Junior University. New York, Henry Holt and Company, 1907. Large 8vo, XVI + 789 pp., 18 colored plates and 673 figures. \$6.00.